IN THE SPECIFICATION

Please amend the specification, as follows:

Page 1, Lines 5-9

--This application claims the benefit of US Provisional Patent Applications, Serial No. 60/410,541 ~~(CiDRA Docket No. CC-543)~~, filed Sept. 12, 2002, and is a continuation-in-part of US Patent Applications, Serial No. 10/645,689 ~~(CiDRA Docket No. CC-0648)~~, filed Aug. 20, 2003, each of which are incorporated herein by reference in their entirety.--

Page 1, Lines 10-13

--US Patent Application Serial No. . 10/661,234 ~~(CiDRA Docket No. CC-0648A)~~, and Application Serial No. 10/661,082 ~~(CiDRA Docket No. CC-0650)~~, filed contemporaneously herewith, contains subject matter related to that disclosed herein, which is incorporated by reference in its entirety.--

Page 2, Lines 6-11

--According to the present invention, a method of manufacturing an optical identification element is provided. The method includes providing a substrate and winding at least two or more wraps of the substrate around a device to provide at least one grating writing section. The method further includes writing in a single exposure at least one grating into the at least two or more wraps of the substrate disposed in grating writing section, and splitting the

substrate disposed in the at least one grating writing section to form a multiplicity ~~plurality~~ of optical identification elements.--

Page 6, Lines 22-25

--The optical identification element 8 described herein is the same as that described in Copending Patent Application Serial No. 10/661,234 ~~(CiDRA Docket No. CC-0648A)~~, filed contemporaneously herewith, which is incorporated herein by reference in its entirety.--

Page 9, Lines 26-29

--In step 804, the photosensitive fiber 830 is then stripped of the coating or buffer disposed on its outer surface and then cleaned. In step 806, the ~~The~~ stripped fiber is then wound around a cage or basket 832 having a generally polygon shape so that the wound fiber has sections 831 of flat areas.--

Page 10, Lines 9-23

--As best shown in Figs. 5 and 6, the cage 832 has a lower plate 842 and an upper ring support 844 with ~~844with~~ a plurality of rods 846 connected therebetween. The rods are equi-spaced about the circumference of the cage. In the embodiment shown, the cage 832 includes 16 openings 848, however, the invention contemplates having any number of openings. When wound around the rods 846 of the cage 832, each wrap of fiber is adjacent to and touches each adjacent wrap to form a single layer of fiber ribbon 850 around the cage. The

fiber is wrapped around the cage between 100 – 120 times to effectively form a single layer ribbon of fibers. The invention contemplates any number of wraps of fiber around the cage. The fiber ribbon 850 forms a polygonal shape when wrapped around the cage 832 ~~change~~ to provide a plurality of flat sections (16 sections) 831. These flat sections 831 of the fiber ribbon 850 provides the area of the fiber that a grating 12 is written in, which will be described in greater detail hereafter. As best shown in Fig. 6, one section 831 of the fiber ribbon 850 is tape together at 852, including the ends of the fiber, to maintain the tension of the fiber around the cage and to maintain the single layer of the fiber ribbon.--

Page 10, Lines 27-29

--~~In~~ Fig. 7 illustrates that the stripped fiber 830 may by wound around a disk 854 having a plurality of circumferentially spaced dovetailed slots 856, wherein the fiber ribbon 850 is taped at 858 to the outer circumference of the disk.--

Page 11, Lines 1-14

--The next step 808 of Fig. 3 is to write or shoot the diffraction grating(s) 12 into each section 831 (see Figures 8 and 9) ~~846~~ of the fiber ribbon 850. The grating 12 may be impressed in the fiber 830 by any technique for writing, impressed, embedded, imprinted, or otherwise forming a diffraction grating in the volume of or on a surface of a substrate 10. Examples of some known techniques are described in US Patent No. 4,725,110 and 4,807,950, entitled "Method for

Impressing Gratings Within Fiber Optics", to Glenn et al; and US Patent No. 5,388,173, entitled "Method and Apparatus for Forming Aperiodic Gratings in Optical Fibers", to Glenn, respectively, and US Patent 5,367,588, entitled "Method of Fabricating Bragg Gratings Using a Silica Glass Phase Grating Mask and Mask Used by Same", to Hill, and US Patents 3,916,182, entitled "Periodic Dielectric Waveguide Filter", Dabby et al, and US Patent 3,891,302, entitled "Method of Filtering Modes in Optical Waveguides", to Dabby et al, which are all incorporated herein by reference to the extent necessary to understand the present invention.--

<u>Page 11, Line 26, to Page 12, line 5</u>

--Fig. 8 shows the method of writing a grating 12 into the fibers 830 of the ribbon 850 using at least one phase mask 860. A laser 862, such as an excimer laser or CO_2 laser, provides an ultra-violet (UV) beam 864, which passes through the phase mask to write a grating 12 having a predetermined profile corresponding to the phase mask. In one embodiment, one phase mask 860 may be used to write the grating into the fiber 830 to provide <u>one</u> ~~ne~~ unique code for the microbead 8. Each unique phase mask therefore represents one unique code, thereby requiring a phase mask for each code used. Using only one phase mask to generate each code becomes very expensive and difficult to manufacture when the number of unique codes needed increases.--

<u>Page 13, Lines 10-18</u>

Fig. 10 illustrates a scanning method for exposing each section 831 of the fiber ribbon 850 using a phase mask 860. In this method, the width of the UV beam 864 used to write the grating 12 is smaller than the width of the fiber ribbon 850. The UV beam 864 translates along the width of the fiber ribbon to scan each of the wraps of fiber 830 in the section of fiber ribbon. In this instance, the beam scan direction 876 is from bottom to top, however, the direction of scan may be from top to bottom of the section. The UV beam 864 may be scanned upward by translating the laser 862, or alternatively, the cage 832 may translated upward and downward in the axial ~~axially~~ direction.--

Page 14, Lines 6-16

--In step 814, the fiber ribbon 850 is flattened and mounted to a thermally conductive fixture 884, as shown in Figs. 13 and 14. As best shown in Fig. 14, each ribbon 850 is bonded to a plastic sheet material 886 (e.g., polyimide sheet material) that is bonded to the fixture. The adhesive 888 used to bond the polyimide sheet 886 to the fixture 884 and the fiber ribbon 850 to the polyimide sheet is a water-soluble thermoset adhesive, such as that known ~~know~~ as Aquabond ®. In Fig. 13, the fiber ribbons are secured to the fixture by a pair of clamps 890. The length of the fiber ribbons is approximately 632 mm. Once the fiber ribbons are clamped to the fixture 884, the fixture is heated ~~heat~~ to liquefy the adhesive 888, which then encases the fibers 830 in the adhesive. The adhesive 888 is allowed to cool and harden to thereby encase the fibers and bond to the polyimide sheet 886 and bond the polyimide sheet to the fixture.--

Page 15, Lines 15-24

--In step 822 of Fig. 3, the microbeads 8 are cleaned and stored. As shown in Figs. 17 and 18, the vessel 896 is then removed from the vat 902 and a polyethylene vial ~~vile~~ 910 is placed over the tapered opening 898 of the vessel 896, as shown in Figs. 17 – 18. The vessel and vile are then turned upside down and flushed with de-ionized water to clean the microbeads 8. Consequently, the microbeads 8 flow from the vessel 896 to the vial 910. The de-ionized water passes through a dense filter 912 disposed on the bottom of the vial. The polyimide sheet 886 is retained within the vessel 896 because the tapered opening 898 of the vessel is smaller than the sheet. Referring to Fig. 19, another filter 914 is place in the vial 910 to secure the microbeads therein for storage.--

Page 15, Line 25, to Page 16, Line 16

--Figs. 20 and 21 illustrate a method of writing at least one grating 12 in a section 831 of a fiber ribbon 850. In this embodiment, the fiber ribbon, similar to that described hereinbefore, is wound around a spool 916. The fiber ribbon is drawn through a grating writing station 868 to a take up spool 918. The grating writing station 868 includes a carriage 866 having a plurality of phase masks 860 that linearly translates parallel to the flat section 831 of the fiber ribbon 850. The carriage translates to position the desired phase mask in position to write the proper grating 12. As the fiber ribbon is fed to the grating writing station 868, a set of rollers 920 separate the tape 880 from the fibers 830 and directs the tape

away from the ultraviolet (UV) beam 864 to thereby protect the tape from the UV beam. The rollers direct the tape and fibers back together and a pair pinch rollers 922 adhere the fibers 830 back onto the tape ~~taper~~ 880 to form the fiber ribbon 850. In the operation of the writing station 868, each section 831 of ribbon 850 is sequentially positioned in the writing station. When a section of ribbon is positioned in the writing station, the carriage 866 translates to position a desired phase mask 860 between the laser 862 and the fibers 830. The laser then provides the UV beam to write the grating 12 in the fibers 830. The carriage 866 then translates to position another phase mask ~~masks~~ to write a second grating onto the section 831 of fibers 830. This operation continues until all the desired gratings are written. The second spool 918 then draws the next section of fibers 830 into the writing station to write the desired grating(s) into the fibers. The grating(s) written into each section of fibers may be the same or different.--

Page 17, Lines 3-8

-- If the microbeads 8 should be used to perform a chemical experiment or assay similar to that described in US Patent Application No. 10/661,031 ~~(CiDRA Docket No. CC-0649A)~~ and US Patent Application No. (CiDRA Docket No. CC-0651), both filed contemporaneously, which are incorporated hereinby reference, the probe compound or chemical may be coated or applied to the fiber or microbeads at any step in the process of manufacture of the microbeads described hereinbefore.--

Page 17, Lines 9-15

-- Fig. 26 illustrates another method of cutting/dicing the fibers 830 to form the microbeads 8. As shown, after the grating(s) 12 have been written into the fiber (and in this particle instance, coated/tagged with a probe compound (e.g., Oligo), the fiber 830 is fed into a tubular fiber holder 944. As the fiber is pushed through the holder 944, a cutting device 946 having a blade 948 cuts or scores the fiber 830 to the appropriate length, which is then separates the microbead from the fiber by a torque element 950.--

Page 23, Line 18, to Page 24, Line 2

--In Fig. 32, the bits may be detected by continuously scanning the input wavelength. A known optical source 300 provides the input light signal 24 of a coherent scanned wavelength input light shown as a graph 304. The source 300 provides a sync signal on a line 306 to a known reader 308. The sync signal may be a timed pulse or a voltage ramped signal, which is indicative of the wavelength being provided as the input light 24 to the substrate 10 at any given time. The reader 308 may be a photodiode, CCD camera, or other optical detection device that detects when an optical signal is present and provides an output signal on a line 309 indicative of the code in the substrate 10 or of the wavelengths present in the output light, which is directly related to the code, as discussed herein. The grating 12 reflects the input light 24 and provides an output light signal 310 to the reader 308. The wavelength of the input signal is set such that the reflected

output light 310 through an optical lens 321 will be substantially in the center 314 of the Bragg envelope 200 for the individual grating pitch (or bit) being read.--

Page 25, Lines 17-22

--In this case, rather than having the input light 24 coming in at the conventional Bragg input angle θi, as discussed hereinbefore and indicated by a dashed line 701, the grating 12 is illuminated with the input light 24 oriented on a line 705 orthogonal to the longitudinal grating vector 703 ~~705~~. The input beam 24 will split into two (or more) beams of equal amplitude, where the exit angle θ_o can be determined from Eq. 1 with the input angle $\theta_i=0$ (normal to the longitudinal axis of the grating 12).--

Page 25, Line 23, to Page 26, Line 2

--~~In particular, from Eq. 1, for a given grating pitch Λ1, the +/-1^st order beams (m=+1 and m=-1), corresponds to output beams 700,702, respectively. For the +/-2^nd order beams (m=+2 and m=-2), corresponds to output beams 704,706, respectively. The 0^th order (undefracted) beam (m=0), corresponds to beam 708 and passes straight through the substrate.~~ In particular, from Eq. 1, for a given grating pitch Λ1, the +/-1st order beams (m=+1 and m=-1) corresponds to output beams 700,702, respectively; the +/-2nd order beams (m=+2 and m=-2) corresponds to output beams 704,706, respectively; and the 0th order (undiffracted) beam (m=0) corresponds to beam 708 and passes straight through the substrate. The output beams 700-708 project spectral spots or peaks 710-718,

respectively, along a common plane, shown from the side by a line 709, which is parallel to the upper surface of the substrate 10.--

Page 26, Lines 3-21

--Referring to Fig. 35, if two pitches Λ1,Λ2 exist in the grating 12, two sets of peaks will exist. ~~In particular, for a second grating pitch Λ2, the +/-1st order beams (m=+1 and m=-1), corresponds to output beams 720,722, respectively. For the +/-2nd order beams (m=+2 and m=-2), corresponds to output beams 724,726, respectively. The 0th order (un-defracted) beam (m=0), corresponds to beam 718 and passes straight through the substrate.~~ In particular, for a second grating pitch Λ2, the +/-1st order beams (m=+1 and m=-1) corresponds to output beams 720,722, respectively; the +/-2nd order beams (m=+2 and m=-2) corresponds to output beams 724,726, respectively; and the 0th order (un-diffracted) beam (m=0) corresponds to beam 718 and passes straight through the substrate. The output beams 720-726 corresponding to the second pitch Λ2 project spectral spots or peaks 730-736, respectively, which are at a different location than the point 710-716, but along the same common plane, shown from the side by the line 709. --

Page 28, Line 19, to Page 29, Line 4

--Referring to Fig. 38, instead of using an optical binary (0-1) code, an additional level of multiplexing may be provided by having the optical code use other numerical bases, if intensity levels of each bit are used to indicate code

information. This could be achieved by having a corresponding magnitude (or strength) of the refractive index change (δn) for each grating pitch Λ. Four intensity ranges are shown for each bit number or pitch Λ, providing for a Base-4 code (where each bit corresponds to 0,1,2, or 3). The lowest intensity level, corresponding to a 0, would exist when this pitch Λ is not present in the grating 12. The next intensity level 450 would occur when a first low level δn1 exists in the grating that provides an output signal within the intensity range corresponding to a 1. The next intensity level 452 would occur when a second higher level δn2 exists in the grating 12 that provides an output signal within the intensity range corresponding to a 2. The next intensity level 454 would ~~level 452, would~~ occur when a third higher level δn3 exists in the grating 12 that provides an output signal within the intensity range corresponding to a 3. --

Page 30, Lines 3-7

--Referring to Fig. 30, illustrations (a)-(c), for the grating 12 in a cylindrical substrate 10 having a sample spectral 17 bit code (i.e., 17 different pitches Λ1-Λ17), the corresponding image on the CCD (Charge Coupled Device) camera 60 is shown for a digital pattern 17 bit locations 89, including Figure 30 illustrations (b), (c) and (d), respectively, of 7 bits turned on (10110010001001001); 9 bits turned on of (11000101010100111); and all 17 bits turned on of (11111111111111111).--

Page 30, Line 20 to Page 31, Line 4

--Referring to Fig. 40, if the value of n1 in the grating region 20 is greater than the value of n2 in the non-grating region 18, the grating region 20 of the substrate 10 will act as a known optical waveguide for certain wavelengths. In that case, the grating region 20 acts as a "core" along which light is guided and the outer region 18 acts as a "cladding" which helps confine or guide the light. Also, such a waveguide will have a known "numerical aperture" (θna) that will allow light 630 that is within the aperture θna to be directed or guided along the grating axis 207 and reflected axially off the grating 12 and returned and guided along the waveguide. In that case, the grating 12 will reflect light having the appropriate wavelengths equal to the pitches Λ present in the grating 12 back along the region 20 (or core) of the waveguide, and pass the remaining wavelengths of light as the light 632. Thus, having the grating region 20 act as an optical waveguide for wavelengths reflected by the grating 12 allows incident light that is not aligned exactly with the grating axis 207 to be guided along and aligned with the grating 12 axis 207 for optimal grating reflection.--

Page 36, Lines 19-27

--Referring to Fig. 52, illustrations (a), (b), (c) a D-shaped substrate, a flat-sided substrate and an eye-shaped (or clam-shell or teardrop shaped) substrate 10, respectively, are shown. Also, the grating region 20 may have end cross-sectional shapes other than circular and may have side cross-sectional shapes other than rectangular, such as any of the geometries described herein for the substrate 10.

For example, the grating region 20 may have an ~~a~~ oval cross-sectional shape as shown by dashed lines 581, which may be oriented in a desired direction, consistent with the teachings herein. Any other geometries for the substrate 10 or the grating region 20 may be used if desired, as described herein.--

Page 35, Line 25, to Page 36, Line 14

--Referring to Fig. 50, illustrations (a), (b), (c), (d), and (e) the substrate 10 may have one or more holes located within the substrate 10. In illustration (a), holes 560 may be located at various points along all or a portion of the length of the substrate 10. The holes need not pass all the way through the substrate 10. Any number, size and spacing for the holes 560 may be used if desired. In illustration (b), holes 572 may be located very close together to form a honeycomb-like area of all or a portion of the cross-section. In illustration (c), one (or more) inner hole 566 may be located in the center of the substrate 10 or anywhere inside of where the grating region(s) 20 are located. The inner hole 566 may be coated with a reflective coating 573 to reflect light to facilitate reading of one or more of the gratings 12 and/or to reflect light diffracted off one or more of the gratings 12. The incident light 24 may reflect off the grating 12 in the region 20 and then reflect off the surface 573 to provide output light 577. Alternatively, the incident light 24 may reflect off the surface 573, then reflect off the grating 12 and provide the output light 575. In that case the grating region 20 may run axially or circumferentially 571 around the substrate 10. In illustration (d), the holes 579 may be located circumferentially around the grating region 20 or

transversely across the substrate 10. In illustration (e), the grating 12 may be located circumferentially around the outside of the substrate 10, and there may be holes 574 inside the substrate 10. In that case, the incident light 24 reflects off the grating 12 to provide the optical light 576.--

Page 34, Lines 20-22

--Referring to Fig. 53, at least a portion of a side of the substrate 10 may be coated with a reflective coating 514 to allow incident light 510 to be reflected back to the same side from which the incident light came, as indicated by reflected light 512.--

Page 37, Lines 4-14

--Referring to Fig. 54, illustrations (a) and (b), alternatively, the substrate 10 can be electrically and/or magnetically polarized, by a dopant or coating, which may be used to ease handling and/or alignment or orientation of the substrate 10 and/or the grating 12, or used for other purposes. Alternatively, the bead may be coated with conductive material, e.g., metal coating on the inside of a holey ~~holy~~ substrate, or metallic dopant inside the substrate. In these cases, such materials can cause the substrate 10 to align in an electric or magnetic field. Alternatively, the substrate can be doped with an element or compound that fluoresces or glows under appropriate illumination, e.g., a rare earth dopant, such as Erbium, or other rare earth dopant or fluorescent or luminescent molecule. In

that case, such fluorescence or luminescence may aid in locating and/or aligning substrates. --